

REMARKS

This is intended as a full and complete response to the Office Action dated June 11, 2003 having a shortened statutory period for response set to expire on September 11, 2003. Claims 86-101 have been allowed. Claims 67 and 78 have been amended to more clearly recite aspects of the invention. Applicants believe no new matter has been introduced by the amendments presented herein. The amendments have been made in a good faith effort to advance prosecution on the merits. Please reconsider the claims pending in the application for reasons discussed below.

In the office action, the Examiner indicated that allowability of claims 32-84 has been withdrawn in view of the newly discovered references to U.S. Patent Publication No. 2001/0015321 (*Reid*), U.S. Patent No. 6,409,903 B1 (*Chung*), U.S. Patent No. 6,340,611 B1 (*Lopatin*) and WO 99/54527 (*Landau*).

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include certain reference signs mentioned in the description. More specifically, the Examiner indicated that Figure 3 does not show the electric current ramp designated by the reference sign 319, as described on page 17, line 13 of the specification. Accordingly, Figure 3 has been amended to add the omitted reference number 319.

The Examiner further indicated that Figures 6A to 6F do not show the metal deposited layer designated by the reference sign 604, as described in page 14, line 33 of the specification. Applicants respectfully submit that the reference sign 604 on Figures 6A to 6F is correct. Therefore, the paragraph beginning on page 14, line 33 in the specification has been amended to replace the reference number 604 with 614 to match the same reference number in Figures 6A to 6F.

The Examiner further indicated that Figures 6E and 6F do not show the spaces designated by the reference sign 622, as described on page 20, lines 10 and 21 of the specification. Accordingly, Figures 6B to 6F have been amended to add the omitted reference number 622.

The Examiner further indicated that the reference numbers 24, 86 and 82 shown in Figure 1 are not identified in the specification. Reference number 24 points to the

same component as reference number 15, which is identified in the specification. Reference number 86 points to the same component as reference number 85, which is identified in the specification. Accordingly, Figure 1 has been amended to delete reference numbers 24 and 86 without prejudice. With respect to reference number 82, the paragraph beginning on page 8, line 10 has been amended to identify reference number 82.

The Examiner further indicated that reference number 200 shown in Figures 2A, 2B and 6A-6F is not identified in the specification. Accordingly, the paragraph beginning on page 3, line 13 and ending on line 27, and the paragraph beginning on page 15, line 10 and ending on line 30, has been amended to identify reference number 200.

The Examiner further indicated that reference number 530 shown in Figure 5 is not identified in the specification. Accordingly, the paragraph beginning on page 8, line 29 and ending on page 9, line 2 has been amended to identify reference number 530 as a pump. Applicants respectfully submit that the objections to the drawings be withdrawn.

Claim 85 is objected to since the phrase “[, the plating voltage being higher than the initial portion of the first biasing voltage]” has not been deleted from the clean version of the claim. Accordingly, the above described phrase has been deleted from claim 85. Applicants respectfully submit that the objection be withdrawn.

Claims 32, 55-59, 61-67 and 78-84 stand rejected under 35 U.S.C. 102(a) as being anticipated by WO 99/54527 with Uziel Landau as the sole inventor (hereinafter *Landau*).

Landau generally describes a method for electroplating a substrate by forming a seed layer on the substrate followed by electroplating copper on the seed layer by applying different currents. For example, to minimize the risk of the seed layer being dissolved in the electrolyte, a voltage is applied to the substrate before the substrate is introduced to the electrolyte, or alternatively, a current is applied instantaneously as the substrate comes into contact with the electrolyte. Further, to improve adhesion of the metal to the seed layer during plating, a very short, high current density strike is applied at the beginning of the plating cycle. Moreover, to completely fill high aspect ration

trenches, vias or other interconnect features, a current reversal or dissolution interval may be applied to achieve some dissolution of the deposited metal. The dissolution interval is preferably applied at a current density much higher than the current density of the deposition current but for a short time interval to ensure a net deposit. The dissolution interval can be applied once or periodically during a deposition process to achieve the desired results. The deposition interval can be divided into a number of short intervals followed by a corresponding number of even shorter dissolution intervals to completely fill high aspect ratio interconnect features.

Landau, however, does not teach or disclose that the second biasing voltage is higher than the first biasing voltage, as recited in claims 32, 67 and 78. *Landau* merely proposes applying a very short, high current density strike at the beginning of the plating cycle to improve adhesion of the metal to the seed layer during plating. Accordingly, claims 32, 67 and 78 are patentable over *Landau*. Claims 33-66, 68-77 and 79-84 are also patentable over *Landau* since they depend from claims 32, 67 and 78, respectively.

The Examiner has rejected various dependent claims over *Landau*. However, because the rejections to the respective base claims have been overcome, Applicants submit that the rejections for the dependent claims have been obviated.

Claims 78-84 stand rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Publication No. 2001/0015321 (*Reid*).

Reid is generally directed to an electroplating process for avoiding defects in metal features of integrated circuit devices. More specifically, *Reid* proposes an entry phase, which includes a method to avoid etching or corrosion of the seed layer within the trenches or vias while achieving full wetting of the wafer surface. Corrosion of the seed layer during the entry phase is mitigated by cathodically polarizing the seed layer with respect to the electrolyte solution. The polarization is achieved by presetting a power supply connected to the wafer to provide a small DC cathodic current at a current density in the range from about 0.02 to 5 mA/cm² just as the wafer is immersed in the electrolyte. *Reid* further proposes an initiation phase to nucleate and grow a relatively thin conformal film onto the seed layer. This phase is achieved by applying a constant low DC cathodic current in the range of between 0.2 and 5 mA/cm².

However, *Reid* is not prior art to claims 78-84 since its filing date (February 28, 2001) is after the claimed invention's filing date, which is July 12, 2000. Assuming *Reid* is not entitled to an earlier priority date, claims 78-84 are patentable over *Reid*.

Claims 33-54, 60 and 68-77 stand rejected under 35 U.S.C. §103(a) as being unpatentable over *Landau* in view of U.S. Pat. No. 6,409,903 (*Chung*). However, neither *Landau* nor *Chung*, alone or in combination, teaches or discloses a second biasing voltage that is higher than the first biasing voltage, as recited in claims 32 and 67. Since claims 33-54, 60 and 68-77 respectively depend from claims 32 and 67, and since neither *Landau* nor *Chung*, alone or in combination, fails to teach, suggest or disclose all the limitations of claims 32 and 67, claims 33-54, 60 and 68-77 are therefore also patentable over *Landau* and *Chung*.

Claims 67 and 68 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. 2001/0015321 (*Reid*) in view of U.S. Patent No. 6,340,633 (*Lopatin*). As mentioned above, *Reid* is not prior art to the claimed invention since it has a filing date later than the claimed invention's filing date. Furthermore, *Lopatin* does not teach, disclose or suggest the second biasing voltage being higher than the first biasing voltage, as recited in claim 67. Since *Reid* is not prior art to claims 67 and 68 and *Lopatin* fails to teach, disclose or suggest the second biasing voltage being higher than the first biasing voltage, claim 67 is patentable over *Reid* in view of *Lopatin*. Claim 68 is also patentable over *Reid* in view of *Lopatin* since it depends from claim 67.

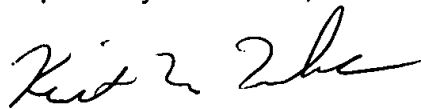
Claims 69-77 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. 2001/001 5321 (*Reid*) in view of U.S. Patent No. 6,340,633 (*Lopatin*), as applied above to claims 67 and 68, and further in view of U.S. Patent No. 6,409,903 (*Chung*). As mentioned above, *Reid* is not prior art to the claimed invention since it has a filing date later than the claimed invention's filing date. Furthermore, neither *Lopatin* nor *Chung*, alone or in combination, teaches or discloses the second biasing voltage being higher than the first biasing voltage, as recited in claim 67. Since claims 69-77 depend from claim 67, and since *Reid* is not prior art and neither *Lopatin* nor *Chung*, alone or in combination, fails to teach, suggest or disclose all the limitations of claim 67, claims 69-77 are therefore also patentable over *Reid*, *Landau* and *Chung*.

The Examiner has rejected various dependent claims. However, because the rejections to the respective base claims have been overcome, Applicant submits that the rejections for the dependent claims have been obviated.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed method or apparatus. Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion of the secondary references is not deemed necessary for a full and complete response to this office action. Accordingly, allowance of the claims is respectfully requested.

Respectfully submitted,



Keith M. Tackett
Registration No. 32,008
MOSER, PATTERSON & SHERIDAN, L.L.P.
3040 Post Oak Blvd., Suite 1500
Houston, TX 77056
Telephone: (713) 623-4844
Facsimile: (713) 623-4846
Attorney for Applicant(s)